NONIN®

Operator's Manual

Avant® 9600

Digital Pulse Oximeter

CE 0123

English

CAUTION! Federal law (USA) restricts this device to sale by or on the order of a physician.

CAUTION! Read this entire manual carefully before using the Avant® 9600 Digital Pulse Oximeter.

The information in this manual has been checked carefully and is believed to be accurate. In the interest of continued product development, NONIN reserves the right to make changes and improvements to this manual and the products it describes at any time, without notice or obligation.

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Guide to Symbols

This table describes the symbols that are found on the Avant 9600.

Regulatory Symbols

	**Attention:** See Instructions for Use or related materials.
	**Type BF Applied Part** (Patient isolation from electrical shock).
	**UL Mark for Canada and the United States** with respect to electric shock, fire, and mechanical hazards only in accordance with UL 60601-1 30EM and CAN/CSA C22.2 No. 601.1.
	**CE Marking** indicating conformance to EC directive No. 93/42/EEC concerning medical devices.
SN	**Serial Number** (located under the back cover).
	**Signal Output** (located on back of unit).
	Indicates separate collection for electrical and electronic equipment (WEEE).
	**Alarm Call** (located on back of unit).

Precautions for Use

Indications for Use

The NONIN® Avant® 9600 Digital Pulse Oximeter is a portable, tabletop device indicated for use in simultaneously measuring, displaying, and recording functional oxygen saturation of arterial hemoglobin (SpO_2) and pulse rate of adult, pediatric, infant, and neonatal patients in hospitals, medical facilities, home care, and subacute environments. It may also be used in patient transport, sleep laboratories, and EMS environments. The Avant 9600 is intended for continuous monitoring and/or spot-checking of patients during both motion and no-motion conditions, and for patients who are well or poorly perfused.

Contraindications

Do not use the Avant 9600 in an MRI environment.

Explosion Hazard: Do not use the Avant 9600 in an explosive atmosphere or in the presence of flammable anesthetics or gases.

Warnings

The Avant 9600 is intended only as an adjunct in patient assessment. It must be used in conjunction with other methods of assessing clinical signs and symptoms.

Oximeter readings of the Avant 9600 may be affected by the use of an electrosurgical unit (ESU).

Use only NONIN-manufactured PureLight® pulse oximeter sensors. These sensors are manufactured to meet the accuracy specifications for NONIN pulse oximeters. Using other manufacturers' sensors can result in improper pulse oximeter performance.

Do not use a damaged sensor.

Do not use the Avant 9600 in or around water or any other liquid when the AC power adapter is used.

As with all medical equipment, carefully route patient cables and connections to reduce the possibility of entanglement or strangulation.

Use the Avant 9600 only with power adapters supplied by Nonin Medical, Inc.

The 9600's Nurse Call feature should not be used as the primary source of alarm notification. The monitor's alarms should be used in conjunction with clinical signs and symptoms to notify medical personnel that an alarm condition exists.

All parts and accessories connected to the serial port of the Avant 9600 must be certified according to at least IEC Standard EN 60950 or UL 1950 for data-processing equipment.

The battery pack must be installed at all times while the device is operating—even when operating on AC power. If it is necessary to operate the device without batteries, audible alarms and memory functions may not be available. DO NOT use the device without batteries when patient safety relies upon audible alarms.

This device should not be used adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, the device should be observed carefully to verify normal operation.

The use of accessories, sensors, and cables other than those listed in this manual may result in increased emission and/or decreased immunity of this device.

The Avant 9600 is designed to determine the percentage of arterial oxygen saturation of functional hemoglobin. Significant levels of dysfunctional hemoglobin, such as methemoglobin, might affect the accuracy of the measurement.

To comply with relevant product safety standards, ensure that all alarm volumes are set appropriately and are audible in all situations.

Cautions

This equipment complies with International Standard EN 60601-1-2:2001 for electromagnetic compatibility for medical electrical equipment and/or systems. This standard is designed to provide reasonable protection against harmful interference in a typical medical installation. However, because of the proliferation of radio-frequency transmitting equipment and other sources of electrical noise in healthcare and other environments, it is possible that high levels of such interference due to close proximity or strength of a source might disrupt the performance of this device. Medical electrical equipment needs special precautions regarding EMC, and all equipment must be installed and put into service according to the EMC information specified in this manual.

Portable and mobile RF communications equipment can affect medical electrical equipment.

If the Avant 9600 fails to respond as described, discontinue use until the situation is corrected by qualified personnel.

Cardiogreen and other intravascular dyes may affect the accuracy of SpO_2 measurements.

The oximeter sensor might not work on cold extremities due to reduced circulation. Warm or rub the finger to increase circulation, or reposition the sensor.

The Avant 9600 has motion tolerant software that minimizes the likelihood of motion artifact being misinterpreted as good pulse quality. In some circumstances, however, the 9600 may still interpret motion as good pulse quality.

Some nail polish colors or artificial nails can reduce light transmission and affect SpO2 accuracy.

Inspect the sensor application site at least every 6 to 8 hours to ensure correct sensor alignment and skin integrity. Patient sensitivity to sensors may vary due to medical status or skin condition.

Do not place liquids on top of the Avant 9600.

Do not immerse the Avant 9600 or sensors in any liquids.

Do not use caustic or abrasive cleaning agents on the unit or sensors.

Do not gas sterilize or autoclave the Avant 9600.

Batteries might leak or explode if used or disposed of improperly.

Follow local governing ordinances and recycling instructions regarding disposal or recycling of the device and device components, including batteries. Use only NONIN-approved battery packs, and remove batteries if the Avant 9600 is not used within 30 days.

This device has not been tested for immunity to electromagnetic disturbances.

When using the 300PS-UNIV battery charger, ensure that the AC cord is plugged into a grounded outlet.

To prevent potential loss of monitoring, do not use ear clip or reflective sensors on pediatric or neonatal patients.

In compliance with the European Directive on Waste Electrical and Electronic Equipment (WEEE) 2002/96/EC, do not dispose of this product as unsorted municipal waste. This device contains WEEE materials; please contact your distributor regarding take-back or recycling of the device. If you are unsure how to reach your distributor, please call Nonin for your distributor's contact information.

To prevent potential loss of monitoring or inaccurate data, remove any objects that might hinder pulse detection and measurement (e.g., blood pressure cuffs).

Manufacturer's Declaration

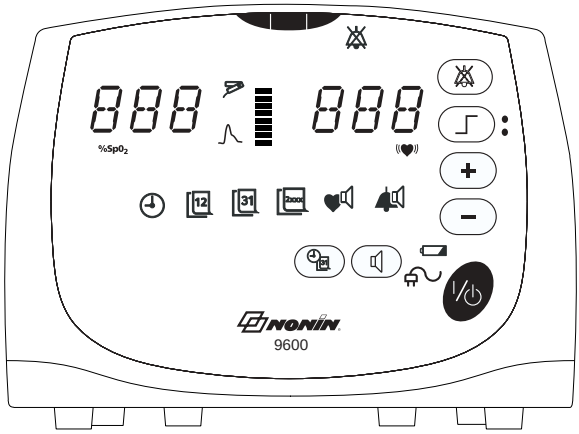
Refer to the following table for specific information regarding this device's compliance to IEC Standard 60601-1-2.

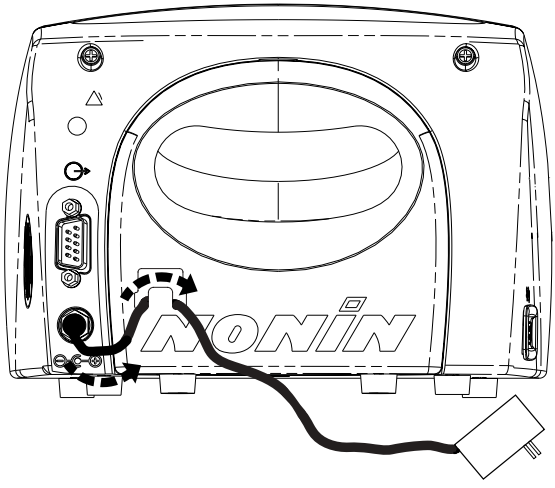
Table 1: Electromagnetic Emissions

Emissions Test	**Compliance**	**Electromagnetic Environment—Guidance**
This device is intended for use in the electromagnetic environment specified below. The customer and/or user of this device should ensure that it is used in such an environment.		
RF Emissions CISPR 11	Group 1	This device uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF Emissions CISPR 11	Class B	This device is suitable for use in all establishments, including domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic Emissions IEC 61000-3-2	N/A	
Voltage Fluctuations/Flicker Emissions IEC 61000-3-3	N/A	

Using the Avant 9600

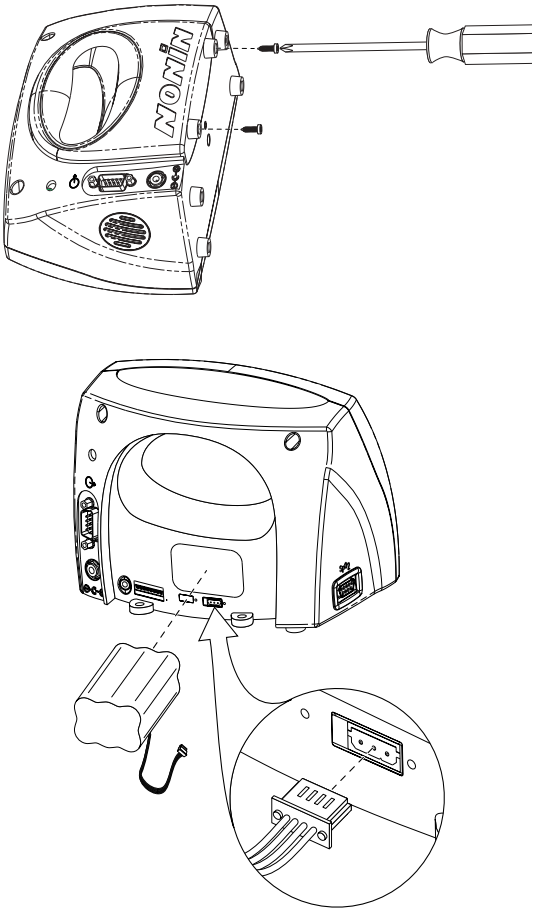
The NONIN® Avant® 9600 Digital Pulse Oximeter is a portable, tabletop device indicated for use in simultaneously measuring, displaying, and recording functional oxygen saturation of arterial hemoglobin (SpO_2) and pulse rate of adult, pediatric, infant, and neonatal patients in hospitals, medical facilities, home care, and subacute environments. It may also be used in patient transport, sleep laboratories, and EMS environments. The Avant 9600 is intended for continuous monitoring and/or spot-checking of patients during both motion and no-motion conditions, and for patients who are well or poorly perfused.





Installing the Batteries

WARNING: The battery pack must be installed at all times while the device is operating—even when operating on AC power. If it is necessary to operate the device without batteries, audible alarms and memory functions may not be available. DO NOT use the device without batteries when patient safety relies upon audible alarms.



NOTE: Contact NONIN to purchase or replace battery packs.

NOTE: Reposition the back cover carefully, and tighten the screws firmly—being careful not to over-tighten.

Verifying Avant 9600 Operation

Press the ON/STANDBY button. When the unit is first turned on, the Avant 9600 performs a brief startup (initialization) sequence. Verify that all LEDs illuminate and the unit beeps three times during the first phase of the startup sequence. If any LED is not lit (except the AC Power Adapter LED), do not use the Avant 9600. Contact NONIN Customer Support for assistance.

In order to verify that the Avant 9600 is functioning properly, it is important to monitor SpO_2 and pulse rate readings. Use the following procedure to verify that the pulse oximeter sensor is functioning properly.

1. Ensure that the Avant 9600 is on, with the sensor connected.
2. Apply the pulse oximeter sensor.
3. Verify that a good SpO_2 reading is displayed, that a pulse rate value appears, and that the pulse strength bargraph LED is active.

Displays, Indicators, and Controls

This section describes the Avant 9600's displays, indicators, and controls.

Avant 9600 Parameter Displays

%SpO_2 Display

The %SpO_2 display is located on the upper left-hand corner of the Avant 9600 and is identified by the %SpO_2 symbol. This display shows blood oxygen saturation in percent.

Pulse Rate Display

The pulse rate display is located on the upper right-hand corner of the Avant 9600 and is identified by the symbol. This display shows the pulse rate in beats per minute.

Numeric LEDs

Numeric LEDs display %SpO_2 and pulse rate values. When setting the device, these LEDs also display values for alarm limits, volume, year, month, day, hour, and minute displays. The numeric LEDs are also used for setting Data Output mode.

Under normal conditions, these LEDs display in green. For high priority (patient) alarms, the corresponding values are displayed in red, blinking fast. The values are displayed in amber when reviewing or changing settings.

Indicators and Icons

Main Alarm LED

This LED indicates all alarm conditions. For high priority (patient) alarms, the indicator is displayed in red, blinking fast. For medium priority alarms, the indicator is displayed in amber, blinking slowly.

Pulse Quality LED

This LED blinks to indicate a poor pulse signal. If there is a sustained period of poor quality signals, this LED will illuminate solid.

Pulse Oximeter Sensor LED

This LED indicates when a sensor has become disconnected, has failed, or has not been applied correctly.

Pulse Strength Bargraph LED

This 8-segment tricolor bargraph indicates pulse strength as determined by the oximeter. The height of the Pulse Strength Bargraph LED is proportional to the pulse signal, and the color is determined by pulse strength:

Green = a good pulse strength
Amber = a marginal pulse strength
Red = a low pulse strength, high priority alarm

When displaying battery charge, this LED indicates charge in 12% increments in green, displaying the depleted portion in amber.

Alarm Silence LED

This amber LED indicates that the audible alarm is silenced for two minutes when it blinks. When lit solid, the Alarm Silence LED indicates that the audible alarm volume is set to less than 45 dB.

Time, Month, Day, and Year LEDs

These amber LEDs indicate that the Avant 9600's *Time, Month, Day,* or *Year* displays can be reviewed or adjusted using the Plus (+) and Minus (-) buttons.

Pulse Volume LED

This amber LED indicates that the Pulse Volume can be reviewed or adjusted using the Plus (+) and Minus (-) buttons.

Alarm Volume LED

This amber LED indicates that the Alarm Volume can be reviewed or adjusted using the Plus (+) and Minus (-) buttons.

AC Power Adapter LED

This green LED is displayed when an external power supply is providing power to the Avant 9600. The Avant 9600 battery pack is being charged any time this LED is displayed—even when the device is shut off.

Battery LED

This amber LED indicates a marginal battery charge when blinking. In addition, this LED—when lit solidly—indicates that the battery charge is being displayed or the battery pack is not installed**.** *This LED does not indicate that the Avant 9600 is running on battery power.* The battery charge indication will not be accurate before one full charge/discharge/recharge cycle with a new battery pack.

WARNING: The battery pack must be installed at all times while the device is operating—even when operating on AC power. If it is necessary to operate the device without batteries, audible alarms and memory functions may not be available. DO NOT use the device without batteries when patient safety relies upon audible alarms.

Avant 9600 Front Panel Buttons

ON/STANDBY Button

Pressing this button once turns on the Avant 9600. Holding this button for at least 1 second shuts down the 9600. In Patient Security mode, the ON/STANDBY button must be held for five seconds to shut down the 9600. Momentarily pressing this button while the unit is on displays the battery charge in 12% increments for 3 seconds in green, and initiates either the print-on-demand feature or an event marker.

Time/Date Button

This button displays the time and date. Year, month, day, hour, and minute can be set using the Plus (+) and Minus (-) buttons.

Volume Button

This button allows users to set and review the pulse or alarm volume, depending upon which corresponding LED is illuminated. This button cycles between pulse volume, alarm volume, and normal operation.

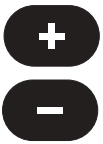
Alarm Silence Button

This button toggles the alarm between silenced and audible. Pressing the Alarm Silence button will silence the alarm for two minutes. When in Latched Alarms mode, pressing this button cancels both audible and visual alarms *if the alarm condition is no longer present.* The two-minute alarm silence is automatically engaged at startup.

Alarm Limits Button and Indicator

This button displays the upper and lower limits for alarm indications for SpO_2 and heart rate measurements. These limits can be adjusted using the Plus (+) and Minus (-) buttons. The Alarm Limits button cycles through the Avant 9600's alarm settings, allowing users to both set and review alarm limits.

The upper LED on the Alarm Limits button indicates the upper alarm limit, and the lower LED indicates the lower alarm limit.



Plus Button and Minus Button

These buttons adjust values for many Avant 9600 functions. The Plus and Minus buttons are used to adjust time, date, volume, upper and lower alarm limits, and data output settings. Pressing either of these buttons alone, when the Avant 9600 is not in any setting mode, adjusts the intensity of the LED displays.

Default Settings

The Avant 9600 features Factory Default and User-Defined Default settings.

WARNING: The battery pack must be installed at all times while the device is operating—even when operating on AC power. If it is necessary to operate the device without batteries, audible alarms and memory functions may not be available. DO NOT use the device without batteries when patient safety relies upon audible alarms.

Factory Default Setting

In Factory Default setting, all adjustable alarm and volume parameters are set at their default values. Factory Default setting is the Avant 9600's default operating setting. It is indicated by option switch 4 in the DOWN position.

User-Defined Default Setting

In User-Defined Default Setting (option switch 4 in the UP position), alarm limit and volume settings must be adjusted. When this setting is first activated, valid limit settings must be entered for SpO_2 alarm limits, pulse rate alarm limits, alarm volume, and pulse rate volume; the Avant 9600 will not return to normal operating mode until all default values have been set. Once set, the adjusted values are used as defaults until the Avant 9600 is turned on with option switch 4 in the DOWN position, at which time the device restarts in Factory Default setting.

NOTE: Patient Security mode overrides default settings.

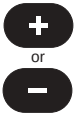
NOTE: In User-Defined Default setting, the lower SpO_2 alarm limit cannot be set below 80.

User Functions

Avant 9600 operating functions can be broken into Basic and Advanced groups.

Basic Functions

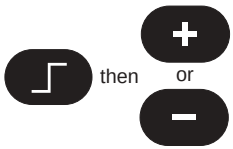
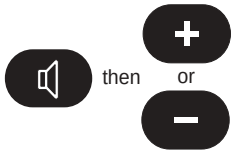
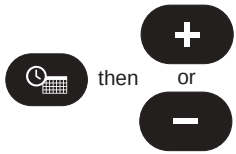
The Avant 9600 has several basic functions, which are easy to use and generally involve only a single button

Function	*Button*	*Instruction*
Turn the Avant 9600 on and off.		Press the ON/STANDBY button to turn on the Avant 9600. Press and hold the button for at least one second to turn off the Avant 9600. In Patient Security mode, hold the ON/STANDBY button for five seconds to turn off the Avant 9600.
Check the battery charge.		Momentarily press the ON/STANDBY button while the unit is on. Battery charge is displayed (in 12% increments, for 3 seconds in green) on the Pulse Strength Bargraph.
Initiate Print-on-Demand		Momentarily press the ON/STANDBY button while the unit is on.
Initiate an event marker.		Momentarily press the ON/STANDBY button while the unit is on.
Mute the audible alarms (2 minutes—toggle).		Momentarily press the Alarm Silence button.
Cancel latched alarms (when in Latched Alarms mode).		Momentarily press the Alarm Silence button.
Adjust the display intensity (brightness).		Momentarily press the Plus or Minus button.

NOTE: When option switch 6 is in the DOWN position, the display intensity will be automatically reduced when the switch from AC to battery power occurs.

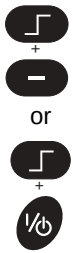
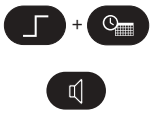
Set Functions

Set functions are those that require multiple buttons to alter a measurement or device parameter for normal operation.

Function	*Button*	*Instruction*
Set alarm limits.		Momentarily press the Alarm Limits button to step through the Limits menu. Use the Plus or Minus buttons to adjust alarm limits.
Set pulse and alarm volumes.		Momentarily press the Volume button to select pulse or alarm volume. Use the Plus or Minus buttons to adjust the selected volume.
Set time and date.		Momentarily press the Time/Date button to step through the Time/Date menu. Use the Plus or Minus buttons to adjust the time and date values.

Advanced Functions

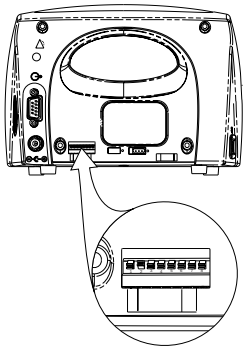
Advanced functions are intentionally more difficult to activate. These functions are restricted to trained users, and they require multiple button presses in order to prevent accidental activation.

Function	*Button*	*Instruction*
Recall Previous Alarm Limit Settings		Press and hold both the Alarm Limits and Minus buttons for three seconds (while the unit is on). or Press and hold both the Alarm Limits and ON/STANDBY buttons when turning on the Avant 9600.
Memory Playback and/or Clear menu		Press and hold the Time/Date button while turning on the Avant 9600. This menu functions with NONIN's nVISION® software. Follow the display prompts after the `Play Bac` message clears. *Note: Memory cannot be cleared when the device is in Patient Security mode.*
Patient Security Settings		Press and hold the Alarm Limits and Time/Date buttons simultaneously for five seconds. The Patient Security mode is displayed in green on the Numeric LEDs. To change the Patient Security mode, press the Volume button while the mode is displayed. The new Patient Security mode is then displayed in amber on the Numeric LEDs.
Serial Output Rate		Press and hold both the Time/Date and Volume buttons simultaneously for three seconds. Use the Plus or Minus buttons to adjust the serial output rate.

Avant 9600 Option switches

The Avant 9600 contains eight option switches that are located under the blue back cover of the unit (See "Installing the Batteries" for instructions on removing the back cover). The UP position faces the top of the unit, and the DOWN position faces the bottom of the unit. **The factory setting for all Avant 9600 option switches is the DOWN position.**

Switch	Function
Switch 1	*Alarm Disable Lock* **Up**—Alarm volume may be disabled **Down**—Alarm volume cannot be set to zero
Switch 2	*Normal / Slow SpO_2 Averaging* **Up**—Slow Averaging (8 beat exponential average) **Down**—Normal Averaging (4 beat exponential average)
Switch 3	*Alarm Unlatched / Latched* **Up**—Alarms Latched **Down**—Alarms Unlatched
Switch 4	*Factory / User-Defined Defaults* **Up**—User-Defined Defaults for Alarm Limits and Volume Settings **Down**—Factory Defaults for Alarm Limits and Volume Settings
Switch 5	*US / International Date Format* **Up**—International Date Format **Down**—US Date Format
Switch 6	*Power Saving Display Dim During Battery Operation* **Up**—Power Saving Disabled **Down**—Power Saving Enabled
Switch 7	*Nurse Call Output* **Up**—Continuous **Down**—Momentary
Switch 8	*Serial Patient Data Output* **Up**—Fast responding SpO_2 and pulse rate output **Down**—SpO_2 and pulse rate output, as selected by option switch 2



Nurse Call Feature

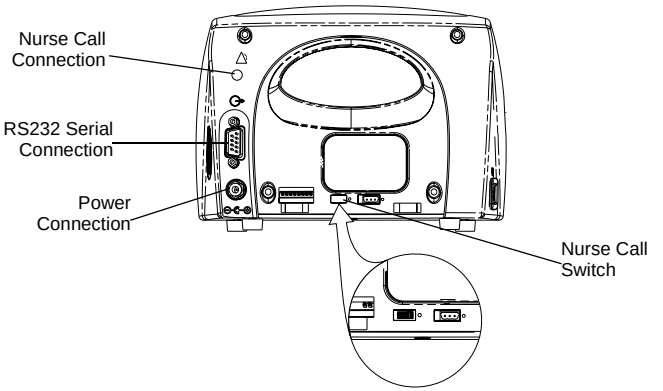
The Avant 9600 features a Nurse Call circuit that can be connected to a hospital nurse call system, allowing alarm conditions to be recognized at a central monitoring location and on the Avant 9600.

Option switch 7 allows users to select the duration output of a signal. In the DOWN position, a one-second signal is active when an audible alarm starts and is repeatedly sent every 60 seconds during the entire duration of the audible alarm. In the UP position, the nurse call signal is active during the entire duration of an audible alarm. The nurse call output signal is active when the 9600 is in Standby mode.

The Nurse Call Circuit can be used both when the Avant 9600 is plugged in and when it is running on battery power. In addition, *the nurse call output operates at any alarm volume setting—including when audible alarms are turned off.*

Included in the Nurse Call Circuit is a switch—located on the base of the back panel and covered by the back cover to prevent accidental toggling—that allows users to select the Nurse Call as either Normally Open (NO) or Normally Closed (NC) relay output.

	Electrical State of Nurse Call Output		
Nurse Call Switch Position	*Nurse Call Not Active*	*Nurse Call Active*	*Standby Mode*
Right	Open	Closed	Closed
Left	Closed	Open	Open



WARNING: It is the user's responsibility to implement the interface between the Nurse Call system and the Avant 9600, and to adequately test the interface between the 9600 and the Nurse Call system to ensure that the desired function is operational.

Care and Maintenance

The advanced digital circuitry within the pulse oximeter of the Avant 9600 requires no calibration or periodic maintenance other than battery replacement.

Field repair of the Avant 9600 circuitry is not possible. Do not attempt to open the Avant 9600 case or repair the electronics. Opening the case will damage the Avant 9600 and void the warranty. If the Avant 9600 is not functioning properly, see "Troubleshooting."

Cleaning the Avant 9600

Clean the Avant 9600 with a soft cloth dampened with isopropyl alcohol. Do not pour or spray any liquids onto the Avant 9600, and do not allow any liquid to enter any openings in the device. Allow the unit to dry thoroughly before reusing it.

IMPORTANT! Do not immerse the Avant 9600 in liquid, and do not use caustic or abrasive cleaning agents on the Avant 9600.

Clean the Avant 9600 separately from its associated sensors. For instructions regarding cleaning pulse oximeter sensors, refer to the appropriate pulse oximeter sensor package inserts.

Alarms and Limits

This chapter describes alarms and limits for the Avant 9600 Digital Pulse Oximeter.

High Priority Alarms

High priority alarms are those that require immediate attention to the patient. They include SpO_2, pulse rate, and low perfusion alarms. On the Avant 9600, high priority alarms are indicated with rapidly blinking red LED displays when alarm limits are met or exceeded. In addition, the pulse strength bargraph LED may illuminate a red segment to indicate low perfusion.

High priority alarms are sounded as follows: “beep, beep, beep,” (short pause), “beep, beep” (10-second pause).

Medium Priority Alarms

Medium priority alarms are those that signal potential problems with the equipment or other non-life-threatening situations. On the Avant 9600, medium priority alarms are indicated with slowly blinking amber displays.

Medium priority alarms are illuminated amber on the Main Alarm LED and on the appropriate indicator(s) or numeric displays, sometimes displaying an error code to help the user identify the source of the error.

Medium priority alarms are sounded as follows: “beep, beep, beep,” (25-second pause), “beep, beep, beep.”

Watchdog Alarms

Watchdog alarms are loud, two-tone, steadily beeping signals that indicate a hardware or software malfunction. When a watchdog alarm is activated, it can be cleared by shutting down the Avant 9600. If the watchdog alarm cannot be cleared, remove the battery and contact your distributor or NONIN Customer Support.

Informational Tones

Informational tones communicate important information. They are typically single “beeps” or a series of three “beeps.” Informational tones include the startup/initialization tone and the pulse rate tone (which changes in pitch with SpO_2 values).

Alarm Summary

The Avant 9600 detects both patient and equipment alarms. In general, patient alarms are identified as high priority, while equipment alarms are identified as medium priority.

Patient Alarms

If patient SpO_2 or pulse readings are equal to or above the upper alarm limit, or if they are equal to or below the lower alarm limit, the Avant 9600 will signal a high priority alarm, indicated by red numeric LEDs that flash in sync with the Main Alarm LED.

High Priority Alarm Description	*Default*	*Adjustment Options*	*Step Value*
SpO_2 Upper Alarm Limit	Off	Off, 80 to 100	1% SpO_2
SpO_2 Lower Alarm Limit	80%	Off, 50 to 95	1% SpO_2
Pulse Upper Alarm Limit	200 BPM	Off, 75 to 275	5 BPM
Pulse Lower Alarm Limit	50 BPM	Off, 30 to 110	5 BPM
Low Perfusion Alarm	Red segment on Pulse Strength Bargraph indicates low patient perfusion.		

Equipment Alarms

Alarm Description	*Visual Indicator*
Low Battery Alarm	Battery LED blinks in sync with Main Alarm LED.
Sensor Alarm	Pulse Oximeter Sensor LED blinks in sync with Main Alarm LED.
Other Equipment Alarms	Amber error code appears in main display area.

Setting and Changing Volume and Alarm Limits

NOTE: Avant 9600 alarm limits reset themselves to default values each time the unit is powered up—unless the unit is in Patient Security mode. In Patient Security mode, alarm limits and volumes cannot be adjusted; they can only be viewed.

Reviewing, Setting, or Changing SpO_2 and/or Pulse Alarm Limits

1. Ensure that the Avant 9600 is on.
2. Press the Alarm Limits button.
   - Notice that the upper round LED is illuminated to the right of the Alarm Limits button. This indicates the upper alarm limit, while the lower LED indicates the lower alarm limit.
   - Notice that the current setting appears in the $\%SpO_2$ display.
   - Continue to press the Alarm Limits button until the alarm limit you want to change is displayed.
   - The Alarm Limits button can also be cycled to exit Set/Change mode, or Set/Change mode will exit automatically after ten seconds with no activity.
3. Ensure that the appropriate upper or lower Alarm Limit LED is illuminated, and that the alarm limit you want to change is displayed.
4. Press the Plus (+) or Minus (-) buttons to adjust the values as desired.

Reviewing, Setting, or Changing Pulse and/or Alarm Volumes

1. Ensure that the Avant 9600 is on.
2. Press the Volume button once to change the alarm volume, or twice to change the pulse volume.
   - After pressing the Volume button once, notice that the Alarm Volume LED appears, and the current setting appears in the Pulse Rate display area.
   - After pressing the Volume button twice, notice that the Pulse Volume LED appears, and the current setting appears in the Pulse Rate display area.
   - The Volume button can also be cycled to exit Set/Change mode, or Set/Change mode will exit automatically after ten seconds with no activity.
3. Use the Plus (+) or Minus (-) buttons to adjust the alarm or pulse volumes as desired.

NOTE: Review "Silencing Alarms" for information about permanently silencing all alarms.

Reviewing, Setting, or Changing Serial Output Rates

1. Ensure that the Avant 9600 is on.
2. Press and hold both the Time/Date and Volume buttons simultaneously for three seconds.
    - The Serial mode will exit automatically after 10 seconds with no activity.
3. Use the Plus or Minus buttons to adjust the serial output to the desired rate. The selectable output rates are as follows:
    - SEr Pod = Print on Demand
    - SER 001 = every second
    - SEr 030 = every 30 seconds
    - SEr 060 = every minute
    - SEr 300 = every 5 minutes
    - SEr 600 = every 10 minutes
    - SEr 900 = every 15 minutes

Silencing Alarms

Press the Alarm Silence button to silence alarms for two minutes. In order to permanently silence all alarms, option switch 1 must be placed in the UP position. This allows the alarm volume to be set to zero. *The Alarm Silence LED will remain illuminated when the alarm volume is set to less than 45 dB.* Refer to "Avant 9600 Option Switches" for more information.

Recalling Previous Settings

The Avant 9600 includes a feature that allows all previous user-defined alarm limit and volume settings to be recalled. The following settings are recalled when this feature is activated:

- SpO_2 high and low alarm limits
- Pulse rate high and low alarm limits
- Alarm volume settings
- Informational tone volume settings

Previous user-defined settings can be recalled by pressing and holding the Alarm Limits and Minus buttons for three seconds while the unit is on, or by pressing and holding both the Alarm Limits and ON/STANDBY buttons when turning on the Avant 9600.

Latched and Unlatched Alarms

The Avant 9600 allows users to select Unlatched or Latched alarms. Option switch 3, located at the bottom of the Avant 9600 behind the back cover, is used to toggle between Latched Alarms and Unlatched Alarms modes. Unlatched mode (option switch 3 in the DOWN position) is the default.

When the Avant 9600 is in Unlatched Alarms mode, the Main Alarm LED and the indication of the alarm source will flash, and the audible alarm will sound until the alarm condition is no longer present.

In Latched Alarms mode, the audible and visual alarms will continue to signal even after the alarm condition is no longer present. Pressing the Alarm Silence button will clear all latched alarms.

NOTE: Only patient alarms are selectable as latched or unlatched. Equipment alarms are always unlatched.

Patient Security Mode

When the Avant 9600's Patient Security mode is enabled, users cannot change SpO_2 or Pulse Rate limits—though it is still possible to view those limits. In Patient Security mode, users cannot view or set the alarm volume, pulse volume, or time and date.

When the Avant 9600 is turned on in Patient Security mode, **"111 111"** blinks three times in amber on the display area, and three informational tones are sounded. The upper alarm limits are then displayed, followed by the lower alarm limits.

NOTE: Patient memory cannot be cleared when the Avant 9600 is in Patient Security mode.

NOTE: Patient Security mode is not disabled when the unit is turned off.

Viewing and Changing Patient Security Mode

1. Press and hold *both* the Alarm Limits button and the Time/Date button for 5 seconds.
    - The state of Patient Security mode is displayed in green on the Numeric LEDs for 3 seconds: "111 111" is displayed when Patient Security mode is enabled; "000 000" is displayed when Patient Security mode is disabled.
2. To change Patient Security mode from its current setting, press the Volume button while the mode is displayed. The new state of Patient Security mode is displayed in amber on the Numeric LEDs for 2 seconds.

NOTE: Alarm limits cannot be changed when the Avant 9600 is in Patient Security mode. Patient Security mode prevents accidental changes to critical parameters. The Avant 9600 allows users to lock and unlock alarm limits, volume settings, time settings, and time required to turn off the device.

Error Codes

The Avant 9600 includes error codes that indicate problems with the unit. To correct error conditions, perform the following steps:

1. Turn the unit off and then back on again to remove the error code.
2. If the error persists, disconnect all power (AC and battery), and then reconnect the power and turn the unit back on.
3. If the error still persists, note the error code and contact Nonin Customer Support at (800) 356-8874 (USA and Canada) or +1 (763) 553-9968.

Communication

This chapter describes the memory playback and real-time capabilities of the Avant 9600 Digital Pulse Oximeter.

Memory Features

The Avant 9600 can collect and store more than 115 hours of SpO_2 and pulse rate information.

Data may be played back with data retrieval software (NONIN's nVISION® software is recommended). If you wish to create your own software, contact NONIN for the data format.

The memory in the Avant 9600 functions much like an "endless loop" tape. When the memory fills up, the unit begins overwriting the oldest data with the new data.

IMPORTANT! Data is overwritten ONE RECORD AT A TIME—so if the entire memory is filled with a single record, that entire record will be deleted when a new record begins.

Each time the Avant 9600 is turned on, the current time/date information (if the clock is set properly) is stored in memory, starting a new recording session. Only recording sessions greater than one minute in length are stored in memory.

Patient SpO_2 and pulse rate are sampled every 2 seconds. Every 4 seconds, the extreme value of the 4-second sample period is stored. Oxygen saturation values are stored in 1% increments in the range of 0 to 100%.

The stored pulse rate ranges from 18 to 300 pulses per minute. The stored values are in increments of one pulse per minute in the interval from 18 to 200 pulses per minute, and in increments of 2 pulses per minute in the interval from 201 to 300 pulses per minute.

WARNING: The battery pack must be installed at all times while the device is operating—even when operating on AC power. If it is necessary to operate the device without batteries, audible alarms and memory functions may not be available. DO NOT use the device without batteries when patient safety relies upon audible alarms.

Playing Back Memory Data

The Avant 9600 has a Memory Playback feature, allowing stored data to be output through the RS-232 serial connection.

1. With the unit off, connect the RS-232 connector port of the Avant 9600 to the back of your computer using a null modem cable.
2. With the Avant 9600 still off, press and hold the Time/Date button while pressing the ON/STANDBY button.
    - All LEDs will illuminate briefly. PLy bac will appear in the SpO_2 and Pulse Rate LED display areas. This message signals that the Avant 9600 is in Playback mode.
3. The PLy bAC message will disappear when memory playback is complete. (Memory playback may take up to 8 minutes, depending upon the amount of data.) Pressing the ON/STANDBY button will exit Playback mode.
4. A CLr no message will be displayed, and three informational tones will sound.
5. (OPTIONAL): To clear the memory:
    - Use the Plus or Minus buttons to select Clr YES.
    - Press the ON/STANDBY button.
    - To confirm the clearing of memory, use the Plus or Minus buttons to select DEL YES.
    - Press the ON/STANDBY button again.
    - dnE CLr confirms that the memory is clear.
6. Press the ON/STANDBY button to return to normal operation.

NOTE: Patient memory cannot be cleared when the Avant 9600 is in Patient Security mode.

Serial Patient Data Outputs

The Avant 9600 features real-time and print-on-demand capabilities. All outputs include a header containing model number, time, and date information.

The Avant 9600 provides real-time data output capability via the RS232 connector port. A null modem cable may be used to connect the Avant 9600 to the receiving computer. The information from the Avant 9600 is sent in an ASCII serial format at 9600 baud with 8 data bits, 1 start bit, and 2 stop bits. Each line is terminated by CR/LF.

Print-On-Demand Output (Default)

The Avant 9600 features a Print-On-Demand option, allowing users to output data each time the ON/STANDBY button is pressed.

Real-Time Patient Data Output

Data are sent once per second by the Avant 9600 in one of the following formats:

- If option switch 8 is in the UP position, the data will be displayed as follows:

  SPO2=XXX HR=YYY F

  where XXX and YYY are the fast-responding SpO_2 and pulse rate values.

- If option switch 8 is in the DOWN position, the data will be displayed as follows:

  SPO2=XXX HR=YYY

  where XXX and YYY are the SpO_2 and pulse rate values as selected by option switch 2.

NOTE: Pressing the ON/STANDBY button will insert a "*" at the end of the corresponding printed line to serve as an event marker.

Using the Avant 9600 with Philips VueLink

VueLink is a general purpose interface that facilitates communication between devices. The Avant 9600 supports the VueLink Open Interface (V.O.I.), and will interface with a Philips VueLink Auxiliary Plus Type B module (product number M1032A#A05).

Connecting the Avant 9600 with the VueLink Module

The Avant 9600 is connected with the VueLink Module via a Philips cable (product number M1032A#K6C), which is connected to the Avant 9600's RS-232 Serial Connection. The Avant 9600 detects the VueLink connection and begins communication automatically. Disconnecting the cable or turning off the Avant 9600 will stop communications.

When the Avant 9600 is connected to the VueLink module and interfaced to a multiparameter monitor, the following data will be sent for display:

- plethysmographic waveform
- SpO_2 data, as displayed on the oximeter
- pulse rate data, as displayed on the oximeter

  NOTE: When dashes are displayed for SpO_2 or pulse rate data, the oximeter identifies that data as "not available" to the VueLink module.

- high and low SpO_2 and pulse rate alarm limits

  NOTE: Limits set to "off" on the Avant 9600 are reported to the VueLink module as the maximum values of the upper limits and the minimum values of the lower limits.

- alarm conditions (for both patient and equipment alarms)

Patient Alarms

Only one alarm condition can be reported to the VueLink at a time. Because of this, patient alarm conditions are assigned priorities—with only the highest priority alarm displayed at any one time. Alarms are sent to the VueLink even when the oximeter's alarms are silenced. Alarm priorities are assigned as follows:

1. SpO_2 Low Limit
2. Pulse Rate High Limit
3. Pulse Rate Low Limit
4. SpO_2 High Limit
5. Low Perfusion

Equipment Alarms

VueLink displays equipment alarms as "inoperatives." Only one inoperative condition can be reported to the VueLink at a time. Because of this, inoperatives are assigned priorities—with only the highest priority displayed at any one time. Inoperatives are sent to the VueLink even when the oximeter's alarms are silenced. Inoperative priorities are assigned as follows:

1. No SpO_2 Sensor
2. SpO_2 Sensor Fault
3. No SpO_2 Data
4. No Pulse Data
5. Low Battery

The following text strings, associated with the Avant 9600, are sent through the VueLink module for display on the multiparameter monitor:

Parameter	Displayed Text
Displayed High SpO2 Limit	HiSpO2
Displayed Low SpO2 Limit	LoSpO2
Displayed High Pulse Rate Limit	Hi PR
Displayed Low Pulse Rate Limit	Lo PR
SpO2 High Limit Alarm	SpO2: HIGH
SpO2 Low Limit Alarm	SpO2: LOW
Pulse Rate High Limit Alarm	PULSE: HIGH
Pulse Rate Low Limit Alarm:	PULSE: LOW
Low Perfusion Alarm	LOW PERFUSION
Sensor Disconnect	NO SpO2 SENSOR
Sensor Fault	SpO2 SENSOR
No SpO2 Data Available	NO SpO2 Data
No Pulse Data Available	NO Pulse Data
Low Battery	Battery: Pulse Ox

Specifications

OXIMETER

Oxygen Saturation Range ($\%SpO_2$) 0% to 100%

Pulse Rate Range 18 to 300 pulses per minute

Displays

Numeric Displays — 3-digit LEDs, Tricolor (red, green, amber)

Pulse Strength Bargraph LED — Tricolor LED segments

Saturation Accuracy

($\%SpO_2$) (±1 S.D.)* — 70-100%

	8000AA Finger Clip Sensor	*8000J Flex Sensor*
No Motion		
Adults, Pediatrics	±2 digits	±2 digits
Neonates	±3 digits	±3 digits
Motion		
Adults, Pediatrics	±2 digits	±2 digits
Neonates	±3 digits	±3 digits
Low Perfusion		
Adults, Pediatrics	±2 digits	±2 digits
Neonates	±3 digits	±3 digits

Pulse Rate Accuracy 18 to 300 beats/min. (no motion)
60 to 240 beats/min. (motion)

	8000AA Finger Clip Sensor	8000J Flex Sensor
No Motion Adults, Pediatrics, and Neonates	±3 digits	±3 digits
Motion Adults, Pediatrics, and Neonates	±5 digits	±5 digits
Low Perfusion Adults, Pediatrics, and Neonates	±3 digits	±3 digits

Measurement Wavelengths and Output Power

Red — 660 nanometers @ 3 mw nominal

Infrared — 910 nanometers @ 3 mw nominal

Altitude

Operating Altitude — Up to 40,000 feet

* S.D. (standard deviation) is a statistical measure; up to 32% of readings may fall outside these limits.

SYSTEM

Temperature	
Operating	+32° to +122°F (+0° to +50°C)
Storage/Transportation	-22° to +122°F (-30° to +50°C)
Humidity	
Operating	10% to 90% noncondensing
Storage/Transportation	10% to 95% noncondensing
Power Requirements	7.2 volt battery pack (6 cells) or 12 VDC 1.5A AC Adapter
Battery Life	
Operating	minimum 12 hours of continuous operation with a fully charged battery pack
Storage	27 days
Recharge	4 hours
Dimensions	5.5” H x 7.25” W x 4.5” D
Weight	2.2 lbs
Memory	115 hours minimum

Classifications per IEC 60601-1; CAN/CSA C22.2 NO.601.1; UL60601-1 30EM

Type of Protection	Class I (when on AC power with 300PS-UNIV battery charger) Internally powered (on battery power)
Degree of Protection	Type BF-Applied Part
Enclosure Degree of Ingress Protection	IPX0
Mode of Operation	Continuous

Nurse Call

Voltage	30 V, AC or DC (non-polarized), maximum
Current	100mA continuous (maximum)
Output Impedance	30 ohms (maximum)
Ground Reference	Isolated ground
Electrical Isolation	1500 VDC
Output	Normally Open or Normally Closed; switch selectable
Output Connector Type	0.141” phone jack

Serial Port Pin-out

PIN #	*RS-232 FUNCTION*
1	Device Carrier Detect
2	Received Data
3	Transmitted Data
4	Data Terminal Ready
5	Signal Ground
6	Data Set Ready
7	Request to Send
8	Clear to Send
9	Ring Indicator

Parts and Accessories

Model Number	Description
AVANTB	Battery Pack
9600 Manual	Operator's Manual for the Avant 9600
300PS-UNIV	Battery Charger, Universal Desktop with IEC320 Connector
Contact your distributor or NONIN for options.	Cord Set, Charger *(must not exceed 2 meters)*
	.
External Cables	
UNI-RA-0	7.25” 90-degree patient cable
UNI-EXT-X	Patient Extension Cable (select 1, 3, 6, or 9 meters)
9600NC-6	Nurse Call Output Cable (2 meters)
9600NC-10	Nurse Call Output Cable (3 meters)
9600NC-10X	Nurse Call Output Cable (3 meters—without plug)
UNI-RS232	RS-232 Cable
Pulse Oximeter Reusable Sensors	
8000AA-1	Adult Articulated Finger Clip Sensor (1 meter)
8000AA-2	Adult Articulated Finger Clip Sensor (2 meters)
8000AA-3	Adult Articulated Finger Clip Sensor (3 meters)
8000AP-1	Pediatric Finger Clip Sensor (1 meter)
8000AP-3	Pediatric Finger Clip Sensor (3 meters)
8000J	Adult Flex Sensor (1 meter)
8000J-3	Adult Flex Sensor (3 meters)
8008J	Infant Flex Sensor
8001J	Neonatal Flex Sensor

Model Number	Description
Pulse Oximeter Disposable Sensors	
7000A	Adult Finger Flexi-Form II® Sensor, 10 per box
7000P	Pediatric Finger Flexi-Form II® Sensor, 10 per box
7000I	Infant Toe Flexi-Form II® Sensor, 10 per box
7000N	Neonatal Foot Flexi-Form II® Sensor, 10 per box
7000D	Flexi-Form II® Sensor Assortment Pack, 10 per box
Sensor Accessories	
8000JFW	Adult FlexiWrap Sensor Wrap
8008JFW	Infant FlexiWrap Sensor Wrap
8001JFW	Neonatal FlexiWrap Sensor Wrap
8000H	Reflectance Sensor Holder System
8000S	Patient Simulator
Other Accessories	
nVISION®	nVISION® software for Microsoft Windows 95/98/2000/NT 4.0 operating systems
Avant RS	Avant Rolling Stand; available in standard or deluxe
Avant PC	Pole Mount Clamp
Avant CC	Carrying case for Avant products

For more information about NONIN parts and accessories, contact your distributor, or contact NONIN at (800) 356-8874 (USA and Canada) or (763) 553-9968. This information is also available on NONIN's website: www.nonin.com.

Service, Support, and Warranty

A return authorization number is required before returning any product to NONIN. To obtain this return authorization number, contact NONIN Customer Support:

Nonin Medical, Inc.
13700 1st Avenue North
Plymouth, Minnesota 55441-5443 USA

(800) 356-8874 (USA and Canada) +1 (763) 553-9968 (outside USA & Canada)
Fax +1 (763) 553-7807 E-mail: mail@nonin.com
www.nonin.com

Warranty

NONIN MEDICAL, INCORPORATED, (NONIN) warrants to the purchaser, for a period of one year from the date of purchase, each Avant 9600 battery pack. NONIN warrants the pulse oximetry module of the Avant 9600 for a period of three years from the date of purchase. Extended warranties are available on most NONIN pulse oximeter models. Please consult your local NONIN distributor for additional information.

NONIN shall repair or replace any Avant 9600 found to be defective in accordance with this warranty, free of charge, for which NONIN has been notified by the purchaser by serial number that there is a defect, provided said notification occurs within the applicable warranty period. This warranty shall be the sole and exclusive remedy by the purchaser hereunder for any Avant 9600 delivered to the purchaser which is found to be defective in any manner, whether such remedies be in contract, tort, or by law.

This warranty excludes cost of delivery to and from NONIN. All repaired units shall be received by the purchaser at NONIN's place of business. NONIN reserves the right to charge a fee for a warranty repair request on any Avant 9600 that is found to be within specifications.

The Avant 9600 is a precision electronic instrument and must be repaired by knowledgeable and specially trained NONIN personnel only.

Accordingly, any sign or evidence of opening the Avant 9600, field service by non-NONIN personnel, tampering, or any kind of misuse or abuse of the Avant 9600, shall void the warranty in its entirety. All non-warranty work shall be done according to NONIN standard rates and charges in effect at the time of delivery to NONIN.

DISCLAIMER/EXCLUSIVITY OF WARRANTY:
THE EXPRESS WARRANTIES SET FORTH IN THIS MANUAL ARE EXCLUSIVE AND NO OTHER WARRANTIES OF ANY KIND, WHETHER STATUTORY, WRITTEN, ORAL, OR IMPLIED, INCLUDING WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY, SHALL APPLY.

Troubleshooting

Problem	Possible Cause	Possible Solution
Avant 9600 will not activate.	The unit has no power.	Plug in the AC adapter.
Avant 9600 will not operate on batteries.	The battery pack is inserted incorrectly.	Check the battery pack connection.
	The battery pack is not charged.	Plug in the Avant 9600 AC Adapter to charge the battery pack.
	The battery pack is inoperable.	Contact NONIN Customer Support for repair or replacement.
You are unable to obtain a green pulse display on the bargraph.	The patient pulse strength is low or perfused poorly.	Reposition the finger or insert a different finger, and keep the sensor motionless for at least 10 seconds.
		Warm the patient's finger by rubbing or covering with a blanket.
		Position the sensor at a different site.
NOTE: In some instances, patient perfusion may be inadequate for pulse detection.	Circulation is reduced because of excess pressure on the sensor (between the sensor and a hard surface) after inserting finger.	Allow the hand to rest comfortably without squeezing or pressing the sensor on a hard surface.
	The finger is cold.	Warm the patient's finger by rubbing or covering with a blanket.
		Position the sensor at a different site.

Problem	Possible Cause	Possible Solution
Unable to obtain a green pulse display on the bargraph, cont'd.	The sensor is applied incorrectly.	Apply the sensor correctly.
	There is possible interference from one of the following sources: • arterial catheter • blood pressure cuff • electrosurgical procedure • infusion line	Reduce or eliminate any interference. Make sure that the sensor is not placed on the same arm being used for other patient therapies or diagnostics (e.g., blood pressure cuff).
	The red LED is not illuminated in the finger insertion area.	Ensure that the sensor is securely attached to the Avant 9600.
		Check the sensor for any visible signs of deterioration.
		Contact NONIN Customer Support.
Frequent or steady pulse quality indication.	There is excessive ambient light.	Shield the sensor from the light source.
	The Avant 9600 is applied to a polished or artificial fingernail.	Apply the sensor to a finger without artificial or polished nails.
		Position the sensor at a different site.
	The red LED is not illuminated in the finger insertion area.	Ensure that the sensor is securely attached to the Avant 9600.
		Check the sensor for any visible signs of deterioration.
		Contact NONIN Customer Support.
	Patient motion is excessive.	Reduce patient motion.

Problem	Possible Cause	Possible Solution
A dash (-) appears in the %SpO_2 display.	A poor signal from the finger is being detected.	Reposition the finger or insert a different finger and keep the sensor motionless for at least 10 seconds.
		Position the sensor at a different site.
	The finger was removed from the sensor.	Reinsert the finger and keep the sensor motionless for at least 10 seconds.
	The Avant 9600 is not functioning.	Turn the unit off, check all connections, and retry.
		Contact NONIN Customer Support.
An error code appears in the display area.	The Avant 9600 encountered an error.	1. Turn the unit off and then back on again to remove the error code. 2. If the error persists, disconnect all power (AC and battery), and then reconnect the power and turn the unit back on. 3. If the error still persists, note the error code and contact NONIN Customer Support.

Problem	Possible Cause	Possible Solution
The unit is in Alarm mode, but no audible alarms can be heard.	The 2-minute Alarm Silence button is activated.	Press the Alarm Silence button to re-engage alarm volume, or wait for two minutes—and alarm tones will automatically re-engage.
	Option switch 1 is in the UP position, and the unit's volume is set to zero.	Adjust the alarm volume, or return option switch 1 to the DOWN position if you desire audible alarms.
The Avant 9600 does not record data.	The battery is low.	Recharge the battery.
	The battery is missing.	Contact your distributor or NONIN Customer Support for repair or replacement.

If these solutions do not correct the problem, please contact NONIN Customer Support at **(800) 356-8874** (USA and Canada) or **+1 (763) 553-9968**.